DOCUMENT RESUME

ED 314 280 SE 051 155

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TITLE Geology: Self-Directed Study Units for Grades K-3 and 4-8, Gifted. Easily Adapted for Regular Classroom Use. Zephyr Learning Project.
REPORT NO ISBN-0-913705-04-7
PUB DATE 83
NOTE 85p.; For other units in this series see SE 051 153-162. Drawings may not reproduce well and pp. 1 and 4 contains light type.
AVAILABLE FROM Zephyr Press, 3865 East 34th Street, Suite 101, Tucson, AZ 85732-3448 (ZP13, $16.95).
PUB TYPE Guides - Classroom Use - Materials (For Learner) (051) -- Guides - Classroom Use - Guides (For Teachers) (052)

EDRS PRICE MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS Earth Science; Elementary Education; *Elementary School Science; *Geology; *Gifted; Instructional Materials; Interdisciplinary Approach; Junior High Schools; *Middle Schools; *Science Activities; Science Education; *Secondary School Science

ABSTRACT

Originally designed for gifted students, these reproducible geology units emphasize the use of higher order thinking skills and are appropriate for use in any classroom. Interdisciplinary in content, the units provide a broad view of geology. Included are two complete units, one created for the upper elementary gifted student and the other for the lower elementary gifted student. Suggestions for adapting the materials to fit other classrooms are included. Several learning modalities are designed into the materials to encourage active student participation. (CW)

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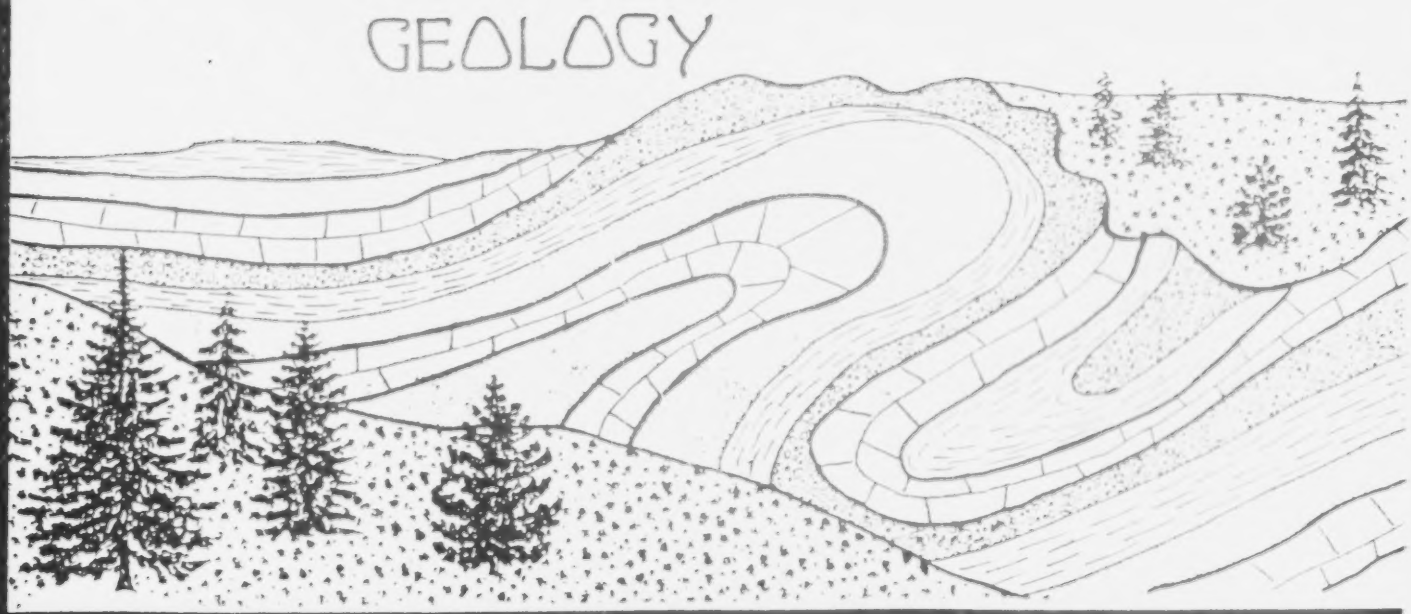
Zephyr Learning Packets

ECOLOGY

A SELF-DIRECTED LEARNING EXPERIENCE
Interdisciplinary – Product Oriented
Grades K – 8

SE 051 155

Zephyr Learning Packet



A self-directed unit promoting CRITICAL and CREATIVE THINKING while researching the world of Geology.

Reproducible Units Grades K—3 and 4—8

GEOLOGY:

Self-Directed Study Units for grades K-3 and 4-8, gifted

easily adapted for regular classroom use

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GEOLOGY:

by Sue Diffenderfer
Joey Tanner
Carolyn Zolg

Self-Directed Study Units for grades K-3 and 4-8, gifted

easily adapted for regular classroom use

Interdisciplinary and
Product Oriented
through the use of:

- Evaluating
- Classifying
- Comparing
- Imagining
- Researching
- Mapping & Charting
- Creating
- Reporting
- Thinking...Reacting
- Career Exploration

ZEPHYR PRESS
TUCSON, ARIZONA

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ISBN 0 913705 04 7
ISBN 0 913705 22 5 (Set)

Book Design: Penny Rebholz

Printed in the United States of America

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THE PREMISE

CHILDREN ARE ACTIVE PARTICIPANTS IN THEIR LEARNING, NOT PASSIVE VESSELS TO BE FILLED. THEY ARE ALWAYS SEEKING AND CHOOSING WHAT THEY WILL LEARN AND WHAT THEY WILL NOT LEARN. THEIR ACTIVE INVOLVEMENT IS CRUCIAL TO LEARNING. CHILDREN TEND TO BECOME PERSONALLY INVOLVED IN PROJECTS THAT APPEAL TO A VARIETY OF MODALITIES . . . READING, WRITING, BUILDING, CREATING, IMAGINING, AND REAL THINKING . . . SO A VARIETY OF EACH IS INCLUDED IN THIS SELF—DIRECTED LEARNING UNIT.

A WORD TO THE TEACHER

GEOLOGY

Our changing earth . . . the story told by the geologists of this fluctuating ball of land and water . . . .

The earth's crust is like a mass of stiff taffy . . . it bulges, stretches, and is squeezed together by powerful forces within. If you were far out in space, watching the earth . . . and time was speeded up so that thousands of years would seem like a second . . . earth might look like a living, pulsing thing:

Mountains rising up, crumbling, folding, and then being worn down flat . . . . . .
Seas advancing over the land and then draining away . . . . . .
Volcanoes bursting up through the ocean and forming new islands. Other lands sinking slowly beneath the sea . . . . . .
The very continents breaking apart into smaller pieces . . . then re-fusing again in other places.

These forces are still at work all around us, slowly, slowly re-creating our world.

"ONE CAN LEARN THE CAMPAIGNS OF THE CIVIL WAR WITH DATES, BATTLES AND CHARACTERS WITHOUT LEARNING ANYTHING ABOUT WHY WARS ARE FOUGHT BETWEEN FRIENDS OR WHAT IDEAS CAN BE GENERALIZED TO OTHER CONFLICT SITUATIONS."

James Gallagher,
Teaching the Gifted Child, 1974

RATIONALE FOR SELF-DIRECTED LEARNING

Our children's education must be more than the memorization of capitals of the states, the products of countries and the dates and places of past wars. Most teachers and parents would agree that what is also wanted is for children to learn to think for themselves, to organize their own time, to make wise choices, to work independently and to thoughtfully evaluate the results of their study.

OBSTACLES TO INDEPENDENT LEARNING

In spite of the teacher's best efforts, many, if not most, classroom settings are organized in such a way that students are involved in schedules and organizational plans that foster dependence rather than the independence we prefer. Students are told what is to be learned and how long it will take them to learn it. The resources are defined by the teacher and, afterwards, the teacher, rather than the student, decides whether the learning experience was a satisfactory and valuable one.

A LEARNING ATMOSPHERE

Each time we, as educators, focus on what our objectives are, we need to take a fresh look at our classroom mode of operation and evaluate the effectiveness of the way we teach. Quite naturally, for most of us, our teaching style has more to do with how we were taught than with what recent research has shown about the learning process. Even our good instincts have been overcome by the years of conditioning we have known in our own educational experiences.

Like a breath of fresh air, the recent findings coming from the research on the brain and how it operates are supporting our intuitive knowledge. This research is showing that our brains are receptive to learning only under certain conditions. Our job is to translate that information into a classroom atmosphere that provides:

- challenge
- freedom within structure
- trust and warmth
- opportunities to experience success
- personal involvement in the curricula

A natural transition generally occurs that transforms the former "teacher-lecturer" into a "fellow-learner". As a "fellow-learner" the teacher's role becomes one of a resource person, a facilitator and a classroom manager. In this maturing atmosphere, students gradually come to see themselves as responsible for their own learning and a foundation for self-direction is set.

• • •

At this point, a sometimes unexpected problem arises. We find the student no more ready for their independent learning than we, as teachers, were ready to allow it. This common occurrence is mentioned repeatedly in the literature dealing with programming for the gifted, an area where independent study and research are recommended as a major curricular activity (see **Suggested Reading List:** Maker (1982), Doherty & Evans (1980), and Feldhusen and Treffinger (1980).

FROM PASSIVE LEARNER TO ACTIVE PARTICIPANT (BRIDGING THE GAP)

The **ZEPHYR** self-directed study unit was developed expressly to bridge that gap . . . to transport the student from the position of passive recipient to that of an active participant in his/her own pursuit of knowledge.

Within the defined structure of each unit, the students are given opportunities to:

- make choices
- learn at their own pace
- learn in a manner more closely suited to their own learning style
- expand research skills
- use a variety of modalities
- plan their own time
- develop the skills of creative, critical and evaluative thinking
- experience whole-brain learning

Since responsibility for directing their own learning is so often an unfamiliar situation, the students will need your encouragement at the start. Generally, within six to nine weeks, most students will be well on their way from teacher dependence to self-motivation. (Beginning the venture with only a few choices, then gradually arranging the setting so that there are more and more choices, works best.) As students assume more responsibility, many teachers begin to consider the school library as just another part of the classroom . . . the benefits are many . . . from gaining a personal relationship with the librarian to learning about the enormous resources available, but often unused, in most school libraries.

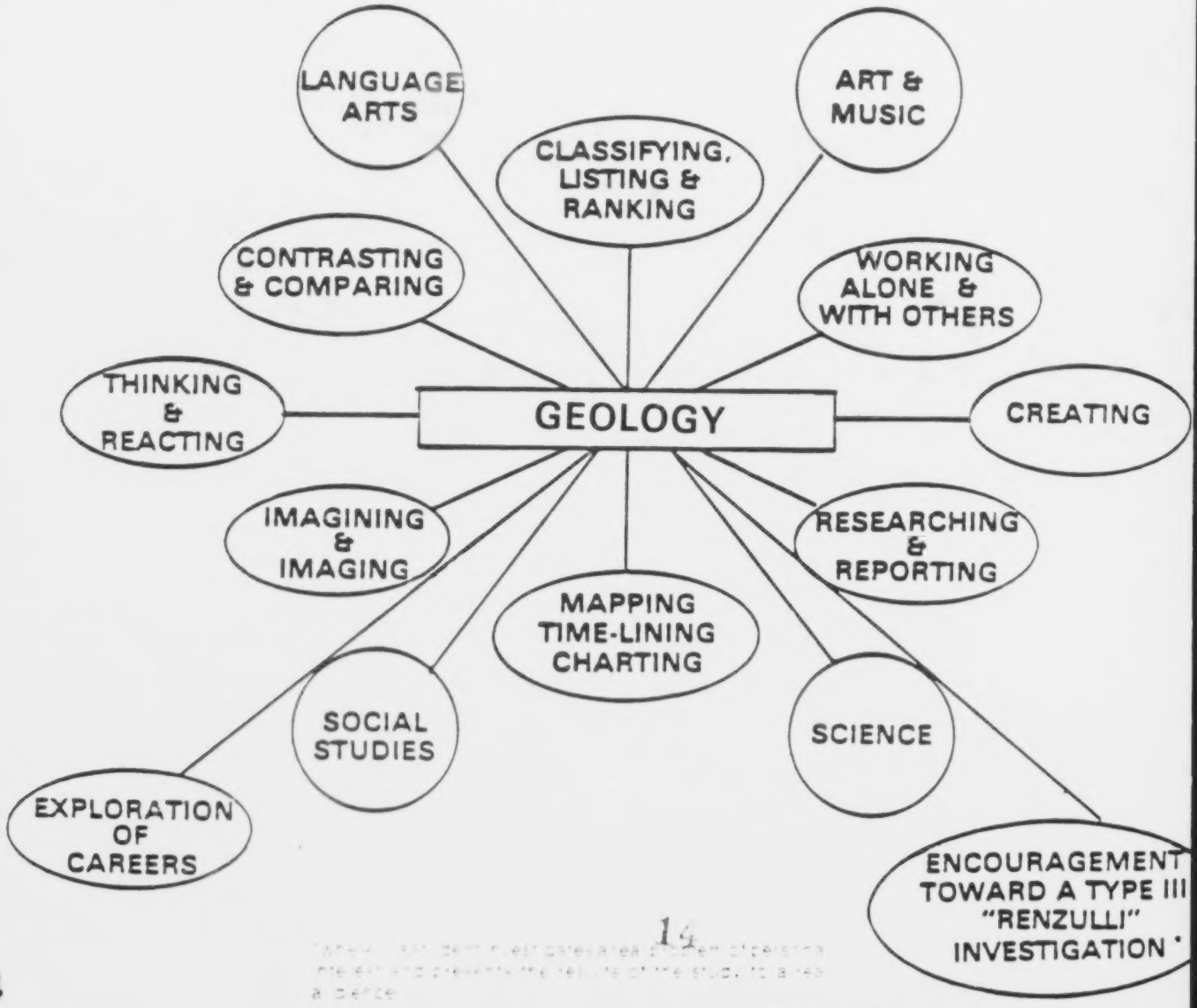
Eventually, a few students will be ready for a true investigative research study of professional quality as suggested by Joseph Renzulli in **The Enrichment Triad Model, A Guide for Developing Programs for the Gifted and Talented**, 1977.

THE FORMAT

Originally developed for the gifted student, these units emphasize the use of the higher level thinking skills ... and are appropriate for use in any classroom where the goal is to encourage students to become responsible for their own education.

Interdisciplinary in content, the unit envelops a broad view of the topic by integrating the "basics" into each activity.

Within this book are two complete units, one created for the upper elementary gifted student and the other for the lower elementary gifted student. Suggestions for adaptations for adjusting either of the levels to fit any individual classroom are included.



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SUGGESTED READINGS

SELF-DIRECTED STUDY

"Bells, Groups and Independent Study", **Psychology and Education of the Gifted.** Barbe, W. and Renzulli, J. New York, 1975. Irvington Publishers.

Creative Questioning and Sensitive Listening Techniques. Carin, A. and Sund, R. Columbus, Ohio, 1978. Charles Merrill Publishing Company.

Creative Thinking and Problem Solving in Gifted Education. Feldhusen and Treffinger. Dubuque, Iowa, 1980. Kendall-Hunt Publishing.

Curriculum Development for the Gifted. Maker, C.J. Rockville, Maryland, 1982. Aspen Systems Corporation.

Enrichment Triad Model: A Guide for Developing Defensible Programs for the Gifted and Talented. Renzulli, J. Mansfield, Connecticut, 1977. Creative Learning Press.

Growing Up Gifted. Clark, B. Columbus, Ohio, 1978. Charles Merrill Publishing Company.

Inviting School Success, A Self Concept Approach to Teaching and Learning. Purkey, W.W.. Belmont, California, 1978. Wadsworth Publishing Company, Inc.

Open to Change: Options for Teaching Self-Directed Learners. Malehorn, H. Palo Alto, California, 1978. Scott Foresman Company.

Self Starter Kit for Independent Learning. Doherty and Evans. Austin, Texas, 1980. Special Education Associates.

Teaching the Gifted Child. Gallagher, J. Boston, Massachusetts, 1975. Allyn and Bacon.

INTEREST DEVELOPMENT CENTER

GEOLOGY

THE PURPOSE OF THE INTEREST DEVELOPMENT CENTER IS TO STIMULATE INTEREST IN THE TOPIC AREA. THE STUDENT NEEDS TIME FOR BROWSING AND INVESTIGATION FOR MAXIMUM BENEFIT.

(Beginning ideas . . . . . you and your students will think of more . . . . . let parents and other teachers know about the Center and it will many times grow without effort.)

ARTIFACTS, such as:

FOSSILS
SEA SHELLS
MICROSCOPE
GLOBE
MAPS
COAL
ROCKS
JEWELS
CRYSTALS
ROCK TUMBLER

BOOKS, POSTERS, FILMSTRIPS ABOUT:

EARTHQUAKES
VOLCANOES
ROCKS
GLACIERS
CRYSTALS
JEWELS
JEWELRY MAKING
COAL
CAVES AND CAVING
ROCK FORMATIONS
GEOLOGIC AGES
OCEANOGRAPHY
TIDES, POOL
UNDERSEA EXPLORATIONS
POLLUTION
ENERGY SOURCES
SONAR
RIVERS OF THE WORLD
AURORA BOREALIS
PLATE TECTONICS

RECORDS & CASSETTES OF SOUNDS OF THE EARTH:

(or music to set a mood)

Recordings of waves crashing, rain falling or thunder crashing are inspiring.

I HEAR ..... AND I FORGET
I SEE ..... AND I REMEMBER
I DO ..... AND I UNDERSTAND
(source unknown)

GETTING STARTED

Select a topic as an extension of a regular curricular subject (particularly when your class seems to crave more) . . . or . . . select a topic to pursue that is of particular interest and may not be part of the curricula. To **zero in on special interests**, administer an interest survey to each student.

2. **Copy the unit for each student.** When using these units for the entire class you may want to expand or delete activities for individual students.

3. **Set up a center** in the classroom **that encourages exploration** in the subject field. You'll want to include a wide variety of materials. **Be creative**, the purpose of the center is to **excite the student in this subject area** so begin with **lots of "hands on" materials . . . . allow for ample browsing time** and **encourage the student to investigate** and become absorbed . . . . **at the level of a true professional.**

With the students, **go over each activity** in the unit, discussing and answering any questions. The **teacher is an integral key** in successful implementation. Because most children are already well-versed in the **"One Right Answer Game"**, they will need encouragement to branch out into many of the open-ended activities in the packets.

5. **Set the stage** . . . plan to **conference as needed** . . . . **provide resources as needed** . . . . then **get out of the way** and let your students learn.

6. **Give as much time** as each student needs to complete each activity in the unit. The entire packet might take from five to ten weeks or longer.

7. As each activity is completed and evaluated, **initial the symbol** located near each activity number. You will want to **evaluate** on the basis of what response is appropriate for **that student.**

8. When a student shows an extreme interest in the topic, the completion of this unit might be only the beginning. This student may well be ready for further study and research and **needs** only the **resources, guidance and freedom** to pursue his/her well-planned project.

In preparation for further research, the student will need to decide:

WHAT WILL THE STUDY BE? (what will be investigated and produced)

WHERE WILL BACKGROUND INFORMATION BE FOUND? (i.e., speakers, interviews, books, films, microfiche, documents, etc.)

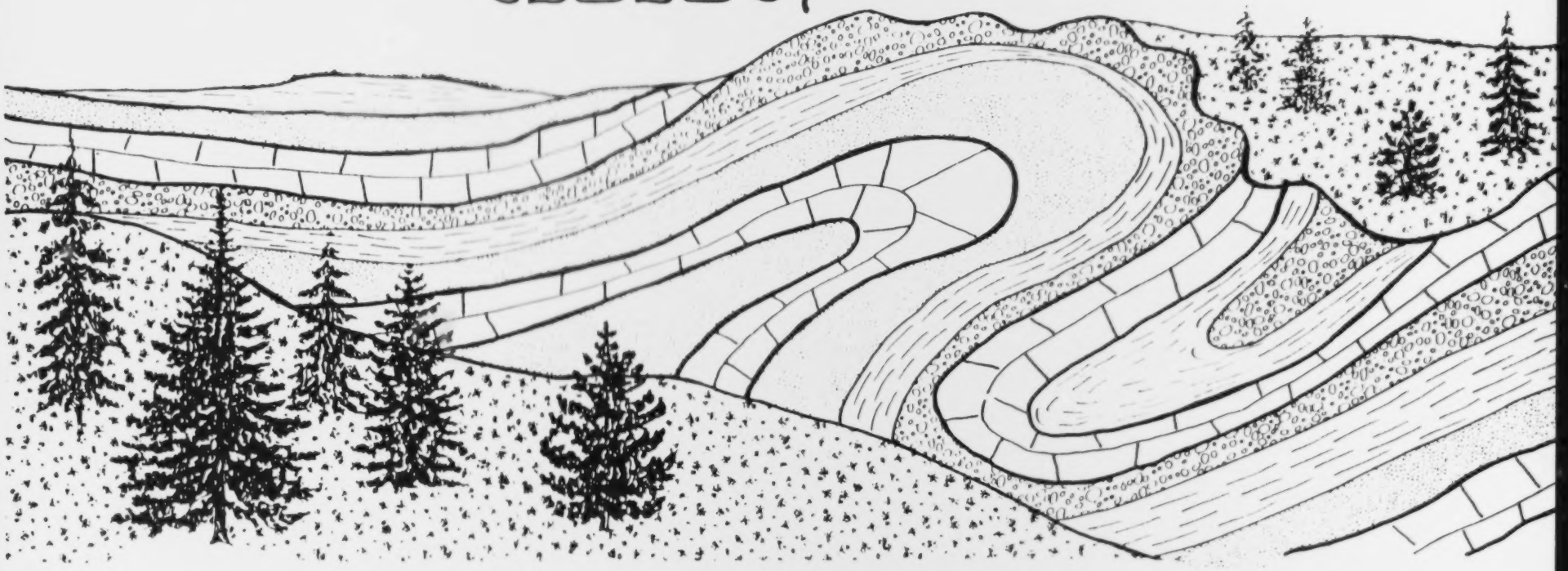
WHAT, EXACTLY, WILL BE THE FORM OF THE PRODUCT? (a model, a manuscript, or . . .)

WHO MIGHT BE INTERESTED IN THE PRODUCT? (professionals in the field, publishers, organizations, etc.)

WHAT IS NEEDED TO BEGIN? (specific plans, resources, deadlines . .)

AGAIN . . . STEP BACK . . . PROVIDE GUIDANCE . . .
and LET HIM/HER GO!

GEOLOGY



UNIT I

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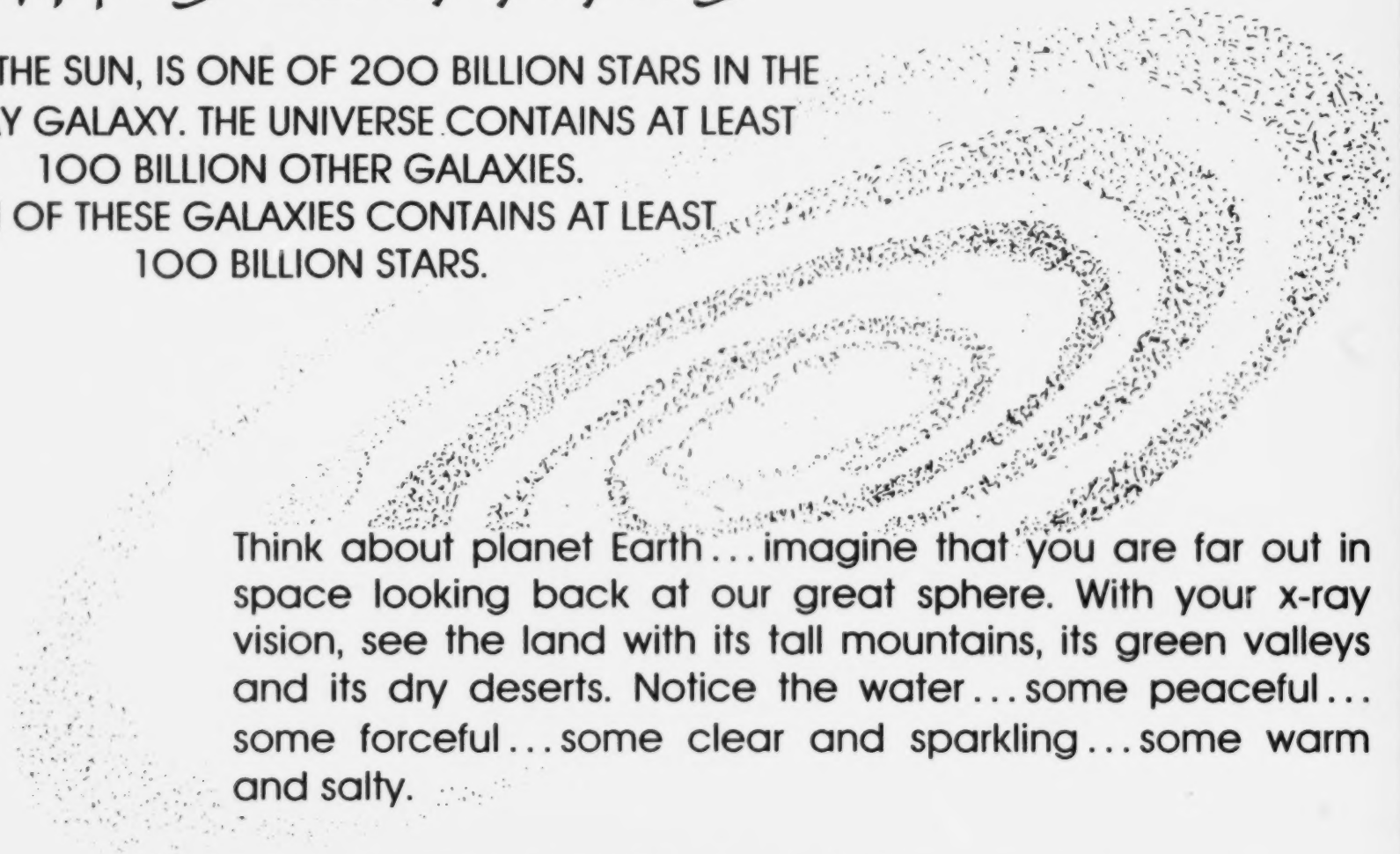
NAME _____

DATE _____

1. EARTH'S BEGINNINGS

OUR STAR, THE SUN, IS ONE OF 200 BILLION STARS IN THE MILKY WAY GALAXY. THE UNIVERSE CONTAINS AT LEAST 100 BILLION OTHER GALAXIES. EACH OF THESE GALAXIES CONTAINS AT LEAST 100 BILLION STARS.



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Think about planet Earth . . . imagine that you are far out in space looking back at our great sphere. With your x-ray vision, see the land with its tall mountains, its green valleys and its dry deserts. Notice the water . . . some peaceful . . . some forceful . . . some clear and sparkling . . . some warm and salty.

LIST three ways planet Earth could have been formed:
(Be creative!)

2. EARTH TALK

TSUNAMI

SPELUNKING

SEDIMENTARY

METAMORPHIC

IGNEOUS

LIMESTONE

GLACIERS

VOLCANOES

EARTHQUAKE

DELTA

LEVEE

CREATE an illustrated picture book showing the meaning of each of these words.

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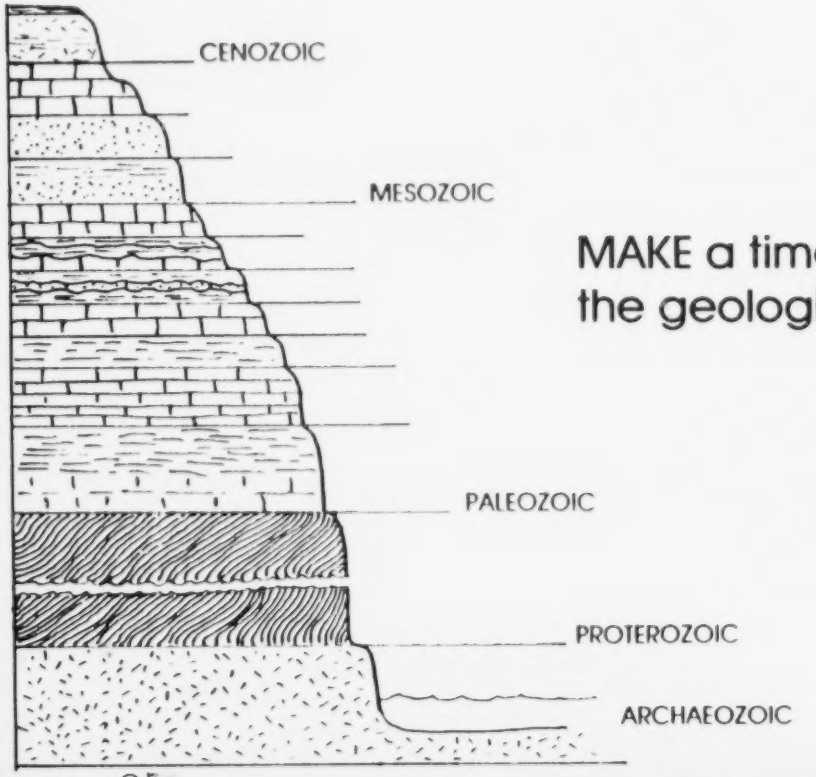
3. Earth: The Planet

THE EARTH IS A ROCKY MASS . . .
8,000 MILES FROM SURFACE TO SURFACE.
IT IS THE THIRD PLANET FROM THE SUN.



MAKE a timeline showing the geologic ages.

OR

CREATE a mobile showing the Earth, the sun and other planets.

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4. WATER of the Earth

WATER SEEMS WEAK . . . BUT SLOWLY OVER YEARS AND YEARS . . . THE WAVES BREAK OFF PIECES OF THE SHORE . . . THE RAIN WEARS AWAY THE MOUNTAINS.

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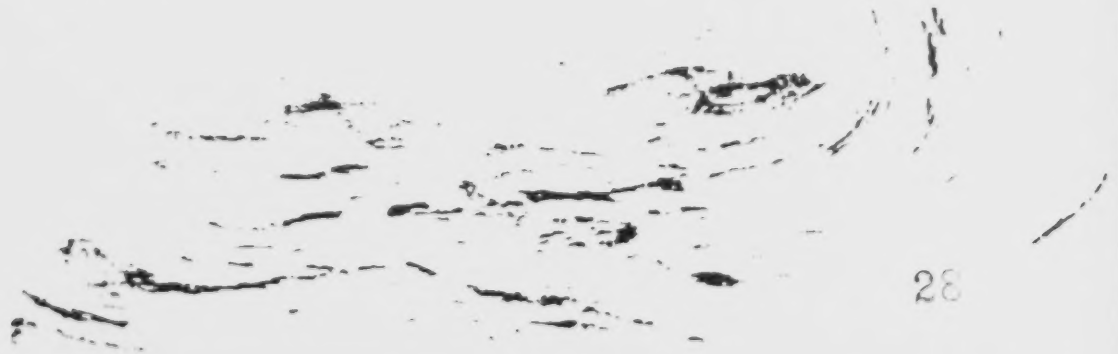
LIST at least 20 adjectives describing water, then WRITE a poem, song or story using these words.

OR

CREATE a collage showing changes in the Earth as a result of water.

OR

WRITE a News Flash about an impending disaster involving water.



5. The Changing Earth

IF YOU WERE OUT IN SPACE . . . AND TIME WAS SPEEDING UP . . .
THE EARTH WOULD LOOK LIKE A LIVING, PULSING THING.

CHOOSE ONE of these powerful forces of change:

GLACIERS VOLCANOES EARTHQUAKES

FIND OUT everything you can about your subject. Then
REPORT THE FINDINGS to your class in a:

- [ ] filmstrip
- [ ] slide show
- [ ] chart
- [ ] model
- [ ] tape recording
- [ ] _____ (your choice)

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⬡ 6. ROCK (choose one)

CREATE a slide show that illustrates how one kind of rock changes into another.

DESIGN a mobile showing the uses of coal.

On a chart, CLASSIFY rocks in as many ways as possible.

PREPARE a 10 card fact file about your favorite jewels.

CREATE a filmstrip showing the life cycle of a piece of chalk.

PUT TOGETHER a booklet illustrating equipment used by a miner.

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7. Saving The Earth's Resources

RESEARCH –

water pollution

alternate sources of fresh water

new construction in your community that involves changes in the earth.

SELECT a controversial issue regarding one of these and present a debate.

OR

PLAN a campaign for "Protecting the Planet". Include bumper stickers, informational fliers and a plan of action.

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8. SPELEOLOGY

IMAGINE that you are an experienced "Caver".

You have been on assignment for National Geographic.

PRESENT YOUR FINDINGS with maps, charts, slides and/or filmstrips.

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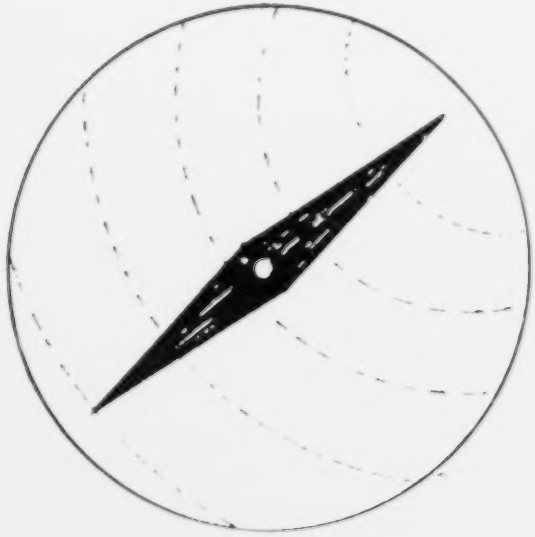
9 MAGNETIC POLES

FIND OUT about the compass
and how it is related to the North and South Poles.

MAKE your own compass.

TEACH at least one person how it works.



Activities, Materials and Resources, Inc. Box 2292 Sierra Vista, AZ 85636

10. Explore Your Community (City & State)

LOOK FOR: Examples of different kinds of rocks

Evidence of Plate Tectonics, volcanoes and earthquakes

Caves with limestone deposits. (Caving is dangerous; do your "exploring" by looking through travel guides and interviewing experienced speleologists)

Information about the water supply

Natural deposits in the earth such as clay, soda, lime, coal, oil...etc...

Fossils

PREPARE a booklet for your library or historical society.

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SUGGESTIONS FOR ADAPTING THE UNIT TO YOUR PARTICULAR TEACHING-LEARNING SITUATION

1. Require fewer, or more, research sources.

2. Assign more of the activities to small groups instead of to individual students.

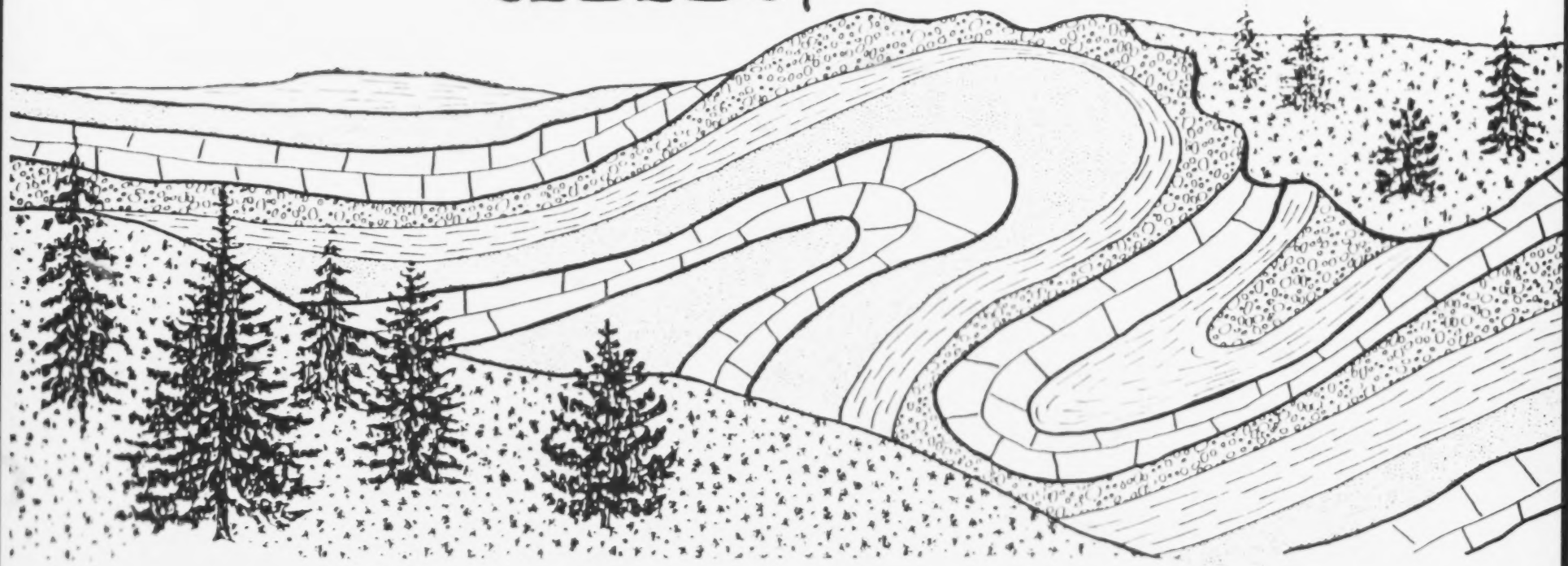
3. Give fewer or more choices.

4. Delete some activities altogether.

5. Arrange the unit to be a class project with students choosing different parts to complete.

6. Add some activities of your own.

GEOLOGY



UNIT II

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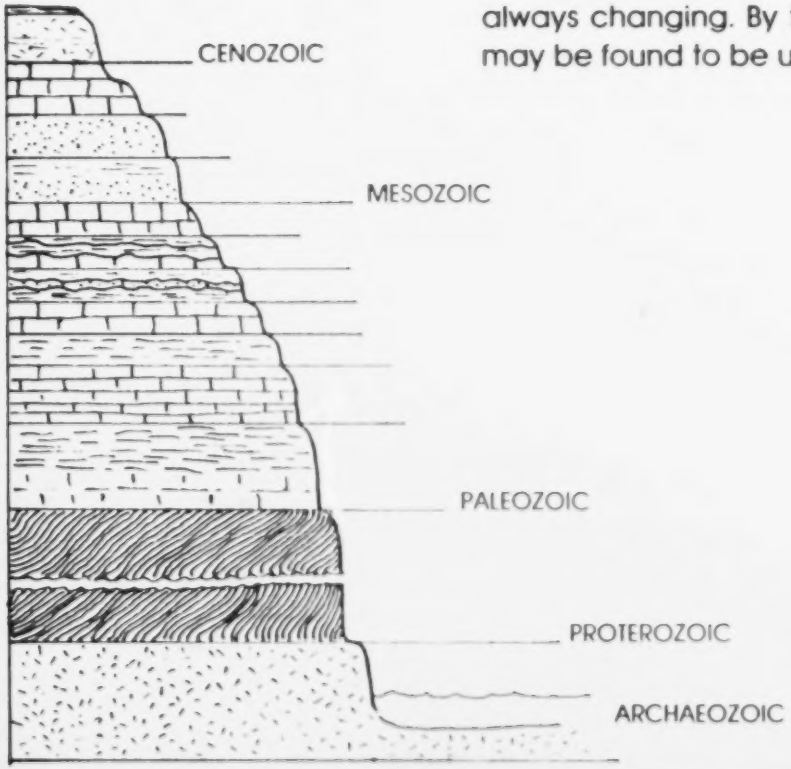
NAME _____

DATE _____

EARTH'S BEGINNINGS

Scientific theories have always been a mixture of keen observation, current knowledge and imagination. Some have been correct, others have been discarded. Always, different beliefs seem to exist at the same time.

A scientist needs an open mind. People have always tried to explain as well as they could. Do some research to discover what people USED to think . . . realizing that knowledge is always changing. By the time you are an adult, some of the things you are learning now may be found to be untrue.



As you read about geology, make a note of each unanswered question and unsolved puzzle that you come across. Those issues are being studied right now.

List these FRONTIERS. Perhaps some of them will be conquered in your lifetime. Maybe YOU will conquer one of them.

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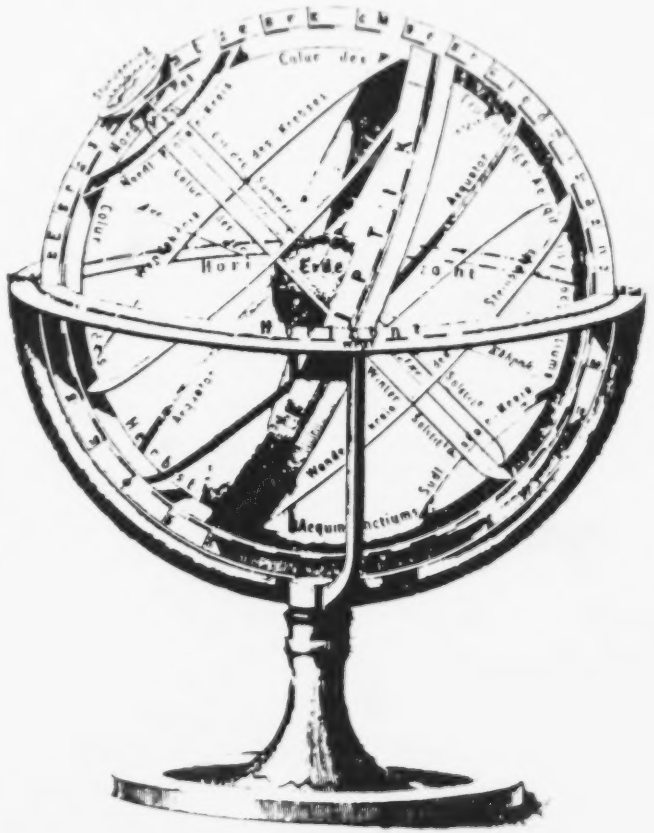
Cont...

The GREEKS knew that earthquakes, water, and volcanoes shape the land. They recognized that the marine fossils of Egypt were evidence that seas once covered the land.

COPERNICUS believed that the Earth rotated and that all the planets moved around the sun.

ARISTOTLE believed that the Earth was a living thing that had grown to its present size.

PTOLEMY believed that the Earth was a great ball with a furnace inside.



In your geology readings, keep your eyes open for the following names. MATCH each one with his contribution to geology.

GALILEO

SIR ISAAC NEWTON

ERNEST RUTHERFORD

JAMES HUTTON

JAMES HALL

WILLIAM SMITH

CHARLES LYELL

LOUIS AGASSIZ

ROBERT MALLET

VAN ALLEN

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GLOSSARY

MARIANAS TRENCH
PLATE TECTONICS
CORE SAMPLER
SAN ANDREAS FAULT
RICHTER SCALE
TSUNAMI
RING OF FIRE
CONTINENTAL SHELF
SPELUNKING
VESUVIUS
BIOSPHERE
GEOTHERMAL
PALEONTOLOGY

SEDIMENTARY
METAMORPHIC
IGNEOUS
LIMESTONE
GREAT ICE AGE
MANTLE
DELTA
LEVEE
CRYSTALLOGRAPHY
ATOLL
TRILOBITE
ARCHAEOLOGY

KNOW SOMETHING ABOUT THESE WORDS
before you begin your study.

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2. The Changing Earth

"EVERY VALLEY SHALL BE EXALTED, AND EVERY MOUNTAIN AND HILL SHALL BE MADE LOW; AND THE CROOKED SHALL BE MADE STRAIGHT, AND THE ROUGH PLACES PLAIN
NOTHING ON EARTH IS SO WEAK AND YIELDING AS WATER, BUT FOR BREAKING DOWN THE FIRM AND STRONG IT HAS NO EQUAL"

- A WAVE TRAVELS THOUSANDS OF MILES, THEN CRASHES AGAINST A SHORE, BREAKS OFF BITS OF ROCKS, SUCKS THEM BACK OUT, AND THEN THROWS THEM INTO THE NEXT WAVE. SLOWLY, OVER THOUSANDS OF YEARS, THE SHORELINE GRADUALLY RETREATS. SOMEWHERE ELSE, SAND MAY BE GENTLY DUMPED AS IT BUILDS UP THE SHORE. THE KIND OF ROCK WILL DETERMINE THE SLOPE OF THE COASTLINE.

  COLLECT as many pictures as you can of different kinds of coastlines.

- AS GLACIERS MELT, THE SEA LEVEL IS RISING (IN SOME AREAS, THREE TO FOUR FEET A YEAR!). IN EARLIER TIMES, IT WAS MUCH HIGHER.

  How do geologists know this? . . . FIND A MAP of the ancient seas. Was your town at the bottom of the sea?

- LAND SINKS AS WELL.
  What is HUDSON CANYON and how is it related to the Hudson River in New York?
  REPORT YOUR FINDINGS.

- Read ISLANDS OF THE OCEAN by Delia Goetz. DEVELOP a "Who Am I?" quiz and survey at least ten friends. FIND OUT what they know about the islands of the world and how the islands came to be.

WATER

WE CALL OUR PLANET "EARTH", BUT IT MIGHT BE MORE FITTING TO CALL IT "WATER".
LOOK AT A GLOBE AND SEE WHAT YOU THINK.

3. Oceans - choose one -

- How are TIDES caused? Where are the highest tides found? What shore animals use the tides' action to surface? ORGANIZE a display with books, posters, and filmstrips. Include any artifacts related to tides and any information you have compiled.

- Could there really be SEA SERPENTS? FIND OUT about as many reports of sightings as possible - ancient and modern. Is there "sea serpent" research going on today? COMPARE AND CONTRAST the attributes of the most unusual animals.

- CREATE a news release warning fishermen, the Navy, or coastline residents about OCEAN CURRENTS. First, find out about:
  - the paths of the currents
  - whether they are warm or cold
  - how climate affects currents
  - how currents are tracked and measured

- INVESTIGATE the SEVEN SEAS of ancient times. How many OCEANS do we count now? CONTRAST on a chart the oceans of "now" and "then".

- What are the potential ENERGY sources that we could get from the ocean? In a mobile, SHOW the possibilities for energy.

- What POLLUTION problems are developing in the oceans of the world? Which countries are the worst offenders? WRITE an editorial describing your solution.

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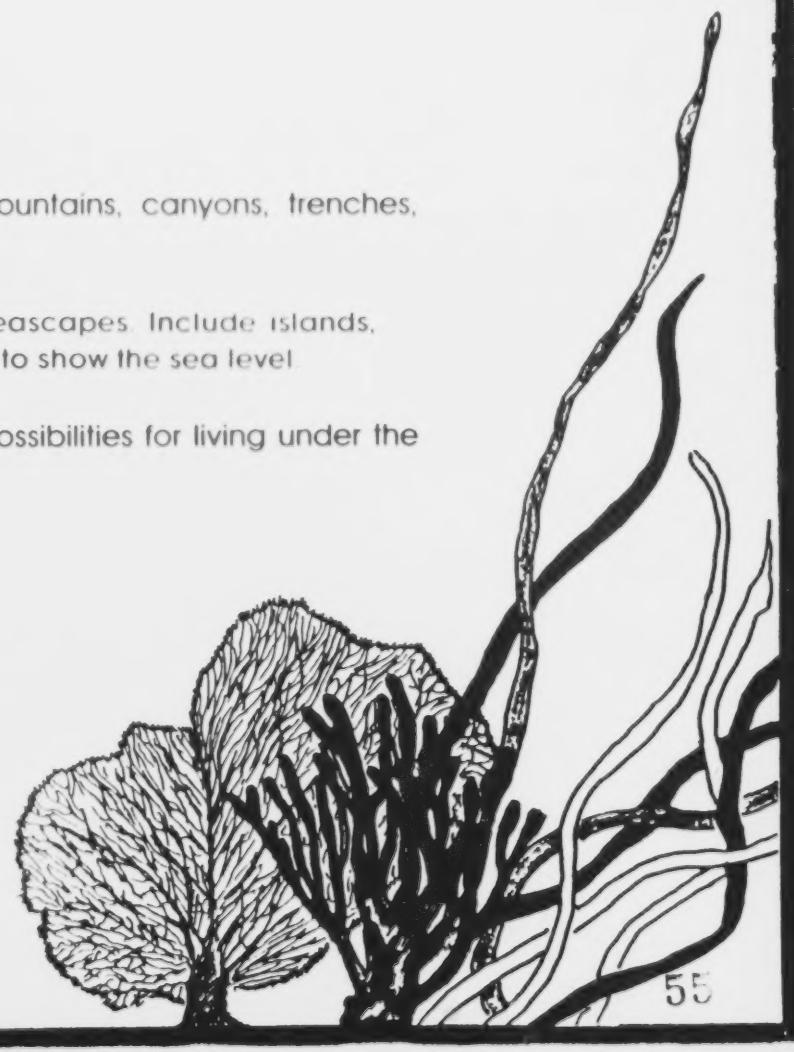
4. The Ocean Floor

RESEARCH the ocean depths. Discover the underwater mountains, canyons, trenches, volcanoes and creatures that live there.

CREATE a papier mache model of the Atlantic or Pacific seascapes. Include islands, continental shelf, slopes, and the mid-ocean trenches. Paint it to show the sea level.

ASSEMBLE a display showing undersea explorations, sonar, possibilities for living under the sea, a core sampler . . . .



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5. Groundwater

THE SURFACE OF THE EARTH IS SOAKED WITH WATER. IT SEEPS DOWN AND DOWN THROUGH ALL THE CRACKS AND TINY SPACES OF THE SOIL UNTIL IT FINDS A LEVEL WHERE ALL THE CRACKS ARE FULL. THIS IS THE WATER TABLE. IT MAY BE ABOVE GROUND OR BELOW GROUND. WHERE DOES IT GO FROM THERE? WHAT MAKES THE LEVEL CHANGE?

CHART the water table of your community from 1900 to the present. What alternative sources are there for fresh water?

OR

CONTACT your local water company or city water department. Find out where your community gets its water. Find out if there is a pollution problem . . . or a potential one. DESIGN a brochure urging people to take action. Distribute it!

6. Lakes

AS BEAUTIFUL AND PERMANENT AS OUR LAKES MAY SEEM, THEY ARE SHORT-LIVED BY GEOLOGIC STANDARDS AND HARDLY MORE THAN "PUDDLES" ON OUR PLANET.

CREATE a poster showing a simple drawing of at least six different types of lakes . . . list the attributes of each one.

OR

MAKE a filmstrip or slide show showing the step-by-step formation of the Great Lakes. Include your hypothesis regarding its future.

Geology 1360 Exploring Water Jackson AZ

⬡ 7. Rivers (choose one)

- FIND OUT ABOUT the controversy regarding the building of the Glen Canyon Dam on the Colorado River. ORGANIZE AND PRESENT a debate on the issues.

- BUILD a papier mache model of at least 3 of the world's mightiest rivers. PREPARE a poster or pamphlet telling the rivers' origins, their changes, how life is affected along their banks, how people use the rivers and whether the rivers are considered "wild" or "tamed."

- The mystery of following an unknown river has captured many an adventuring heart. READ ABOUT some of these explorers and report to your class:
  - John Wesley Powell
  - Lewis and Clark
  - Livingston
  - Tom Sawyer & Huck Finn

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- DEBATE the following issue: One man buys land along a river and uses the water for his fields. Years later, another man builds his home upstream and drains off much of the first man's water. Whose water is it?

- IMAGINE a raindrop or snowflake tossed and blown in a storm, coming to rest on a mountain side. Take it on a journey... WRITE about its many adventures... take it eventually back to how it began... Will your story have an end?

8. MAGNETIC POLES

WHAT ARE THE MAGNETIC POLES? HOW ARE THEY DIFFERENT FROM THE GEOGRAPHIC POLES? HOW DO SCIENTISTS EXPLAIN THE FACT THAT THEY HAVE WANDERED OVER THE YEARS? (WHAT DOES THAT MEAN?) DO WE HAVE A "WOBBLY" EARTH?

THE EARTH IS LIKE A GIANT MAGNET. THOUGH ITS FORCE IS WEAK FOR ITS SIZE, IT WORKS THE SAME WAY AS A SMALL MAGNET. IT, TOO, HAS FIELDS SURROUNDING IT IN SPACE. HOW ARE THEY RELATED TO THE EARTH'S ROTATION?

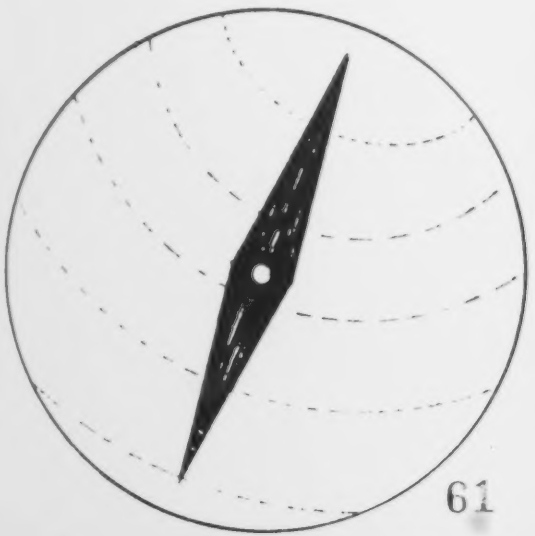
Over each pole, colored light glows and shimmers mysteriously, high in the atmosphere. RESEARCH the AURORA BOREALIS and make a poster that shows what causes it.

OR

TAKE AN IMAGINARY JOURNEY to the center of the Earth. After reading all you can about it, be the first scientist to bore a tunnel to the center. Keep a journal of each day's events on your way. Note the changes in the Earth as you go.

OR

DISCOVER how gravity and tides are cousins. Read WORLD BENEATH THE WAVES by Walter Buehr. Find a friend and develop an experiment that will share your findings with your class.



9. PLATE TECTONICS

SIR FRANCIS BACON, IN THE 1600's, NOTICED THE "FIT" BETWEEN THE COASTLINES OF SOUTH AFRICA AND SOUTH AMERICA.

RESEARCH the theory of PLATE TECTONICS.

Find a map that shows the outlines of the plates. Copy it. Draw the outlines of the continents on the plates. Mark the areas where there are earthquakes, volcanoes and mountain ranges. Notice which edges are crowding closer together and which are separating. Now, cut the pieces apart. Notice areas that have "fused" together.

With some friends, or by yourself, prepare and present a lesson about Plate Tectonics to your class. Discuss:

How scientists measure the amount of drift.
What is happening along the great Mid-Atlantic Rift.
What may eventually happen to Western California.

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10. GLACIERS (choose one)

EVEN NOW, HUGE MASSES OF PACKED ICE COVER 10% OF OUR PLANET... ALWAYS SLOWLY MOVING, CARVING AND SHAPING THE LAND... CARRYING BOULDERS THOUSANDS OF MILES... DIGGING DEEP PITS... SCRATCHING AND SCARRING THE LAND.

- WRITE AND ILLUSTRATE a book about glaciers for someone younger than you. Include information about:

  What and when was the Great Ice Age?
  How much of the earth was covered?
  What happens when a glacier meets the ocean?...a cliff?
  How can ice "bend"?
  What color is it inside a glacier?
  If the Earth's climate warms up, will the ice-cap grow or shrink?
  What are the differences between ice-sheets and glaciers?

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- DRAW a map of the Earth as it would be if all the remaining glaciers melted rapidly.

- There are boulders on the eastern coast of Britain made of a particular rock that is only found in Norway.
  Think like a scientist... HYPOTHESIZE how they might have gotten there. Think of more than one theory and then make a case for your favorite. Present your ideas in a scholarly report. Cite your references.

11. EARTHQUAKES

– CHOOSE ONE –

- INTERVIEW one or more people who have experienced an earthquake. Prepare at least ten questions.

- CREATE a mobile of the most destructive tsunamis. Label it with the name, date, and how far each one travelled.

- DRAW a map of the world and indicate the major earthquake areas.

- DRAW the San Andreas Fault and locate the earthquakes that have happened along its edges during the last 150 years. Circle the major quakes. Is there any pattern evident? PREDICT when you think another will come.

- LEARN how a seismograph works. DRAW a diagram. Are there seismographs set up in your community? Arrange to visit one or have someone come to speak to your class about how they work.

12. VOLCANOES

- CHOOSE ONE –

"PELE' THE GODDESS . . . ROLLING HER ANGER
THRO' BLASTED VALLEY AND FLAMING FOREST
IN BLOOD-RED CATARACTS DOWN TO THE SEA."

- Red-hot lava spilling down the sides of a volcano is obviously destructive. What are the other destructive forces? IMAGINE you have x-ray vision and can see what is happening as a volcano begins to build up. MAKE a drawing that shows the inside. ATTACH some information about what you have learned . . . include information about the SOURCE of heat.

- PUT TOGETHER a chart showing at least 8 well-known volcanoes. CLASSIFY them according to TYPE. Note the date of the eruption, the country where they are found, and the amount of destruction.

- CREATE a filmstrip or slide show of how an undersea volcano can create an island and how the island then becomes a place of life.

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13. ROCKS

IN THE HINDU RELIGION THERE IS A GODDESS, KALI, WHO REPRESENTS THE FORCE OF CREATION AND DESTRUCTION. HOW CAN SOMETHING BE BOTH CREATIVE AND DESTRUCTIVE AT THE SAME TIME? THINK ABOUT THIS AS YOU LEARN ABOUT THE "LIFE CYCLE" OF ROCKS.

- READ about the 3 basic forms of rocks and how one turns into another. MAKE a filmstrip or slide show to illustrate these change processes. When does a rock reach the end of its changing?

- READ THE CURIOUS WORLD OF CRYSTALS by Lenore Sanders (or another book about crystals). CREATE crystal candy or a crystal garden. Observe your creations under a microscope...RESEARCH natural crystals and learn to identify at least three.

- MAKE a 20 card fact file about GOLD, SILVER, and COPPER. Include why they are valuable and how they combine with other minerals and elements...and the many uses of each.

- Oceans advancing and retreating, dinosaurs, swamps, giant insects, land rising, pushing... incredible pressures...this was the COAL AGE. FIND OUT about the formation of carbon and the many uses of coal. CREATE a mobile showing your findings.

- Remember the last time you went to the blackboard . . . give a thought to the piece of chalk you held in your hand. Packed into that cylinder are the remains of billions of tiny one-celled sea animals. IMAGINE the journey of chalk from sea bottom to cliffs to factory. STUDY the formation of sedimentary rock and limestone. WRITE "The Early Life of a Piece of Chalk".

CHOOSE ONE (or more, if you'd like)

14. CAVES

- What are the types of known caves? BUILD a papier mache model of at least 2 types of caves.
- CREATE a mobile or chart showing the equipment of a spelunker. If possible, invite a spelunker to speak to your class.
- If you live in an area of heavily mineralized water, you might see the start of tiny stalactites on your faucet! DRAW a cross-section diagram of a limestone cave showing stalactites and stalagmites. (A good way to remember which is which is this . . . a stalactite grows down from the ceiling and a stalagmite grows up from the ground!)

15. SALT

TRACE the origins of these sayings:

"BACK TO THE SALT MINES"
"PUT SALT ON THE BIRD'S TAIL"
"NOT WORTH HIS SALT"
"POURING SALT IN AN OPEN WOUND"

What do they mean today?

OR RESEARCH some of the sacred and superstitious meanings related to salt. Create a book showing what you have learned.

OR INVESTIGATE floating in a swimming pool versus floating in the ocean. Scientifically explain why man floats and how salt influences floating.

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16. Explore Your Community

EXPLORE your community for unique and unusual geologic features. LOOK for rock formations . . . meteor craters . . . caves . . . old volcanoes . . . fossil beds. IMAGINE you are the first scientist to see the area. Visit it with a tape recorder, a pair of binoculars and a magnifying glass. Make notes describing your observations and reactions as you experience them.

Try to find examples of IGNEOUS, SEDIMENTARY and METAMORPHIC ROCKS.

(Contact your local Federal Geological Office for help in learning about the geology of the land near your home.)

OR

LOCATE old photographs or descriptions of your community — the earlier the better. COMPARE then and now. How has man changed the natural landscape? LIST all the changes you can think of . . . opposite each change write all the effects you can imagine.

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17. CAREERS

GEOCHEMISTRY
GEOPHYSICS
SEISMOLOGY
OCEANOGRAPHY
PALEONTOLOGY
SMITHSONIAN
MINING
FOREST SERVICE
NATIONAL PARK SERVICE
ENERGY CONSERVATION
SURVEYING
SOIL CONSERVATION

LIST 6 qualities necessary for a career in these fields.

For information about educational requirements and job opportunities, write to:

AMERICAN GEOLOGICAL INSTITUTE
1444 N STREET, NW
WASHINGTON, D.C. 20005

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GEOLOGY

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Exploring The Arts

an opportunity to integrate art experiences within an academic content area.

by
Stephany Grassinger

While each component . . . the self-directed learning unit and Exploring the Arts . . . is a complete and valid learning experience in itself, together they provide a more comprehensive and lasting educational experience for the learner.

GEOLOGY

MOTHER NATURE'S COLOR WHEEL

INVESTIGATE the area where you live. What are the colors of the earth? Is the ground a rich brown, black, grey or red? Are the trees a deep dark green, yellow green, blue green, light green . . .?

What about mountains, hills, cliffs . . . ?

DESIGN A COLOR CHART.

This BASIC COLOR VOCABULARY list will help you make your chart:

HUE – the name of a color
INTENSITY – the brightness of a color
VALUE – the lightness and darkness of a color
WARM COLORS – the sun colors...yellows, reds, oranges
COOL COLORS – the water colors...blues, purples, greens

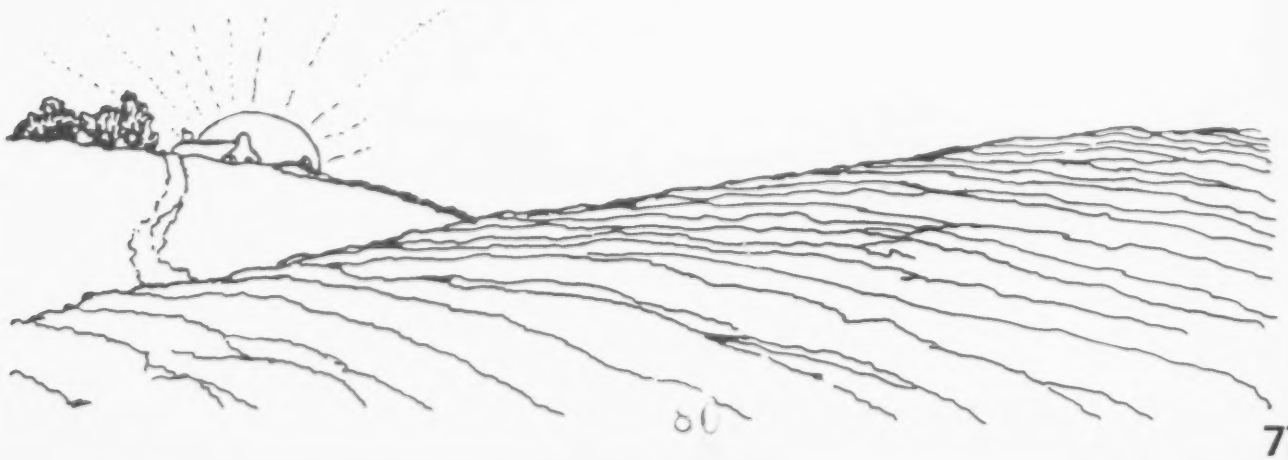
NOW . . .

– LIST the geological characteristics of your landscape on the chart.

– LIST the colors you observe.

– DESCRIBE the intensity and value of the colors.

– DIVIDE your geological characteristics into warm and cool color categories.



DRAW a picture of the landscape where you live. Use oil pastels or crayons to color it. Take your time to mix and blend colors.

REFER to your chart. Are you using all the colors in your landscape?

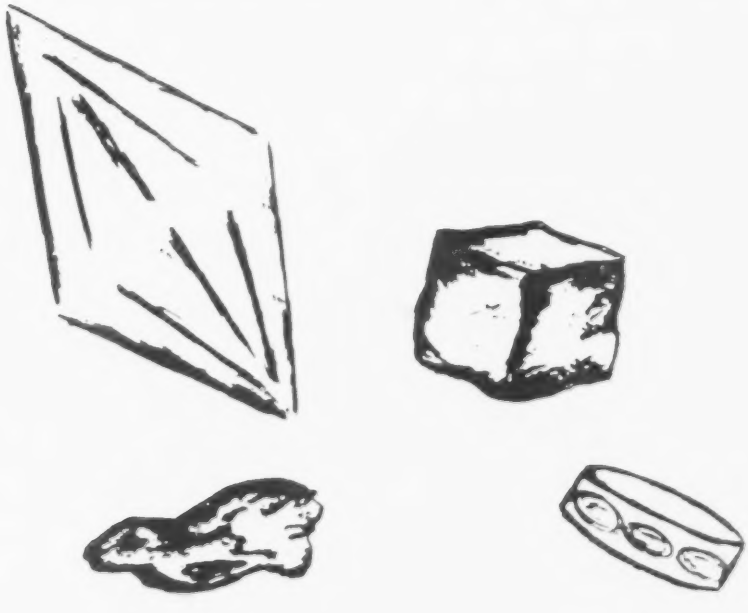
INVITE AN ARTIST

INVITE a goldsmith or silversmith to your classroom.

HINT: Check your telephone book under jewelers or artists...or...Contact your local university or college art department for help in locating an artist.

ASK the artist to:

- demonstrate his/her craft.
- show slides and/or pictures of his/her work.
- talk about the metals and jewels he/she uses.



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DESIGNS BY MOTHER NATURE

THERE ARE MANY BEAUTIFUL DESIGNS IN NATURE...

LOOK...at the cracks in mud dried by the sun
...at the veins in a leaf
...at the arrangement of flower petals
...at the ribs on a seashell
...at the movement of water

SELECT a design by Mother Nature. Use her art work as an inspiration for a design of your own.

HINTS...use the same shapes and repeat them.
...vary the sizes
...overlap the shapes
...change the direction of the shapes
...use paper at least 9"x12" so you have room to experiment different ways

DRAW your design with ONE color marker. After you have completed the drawing, add color to it if you wish.

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TEXTURES FROM NATURE

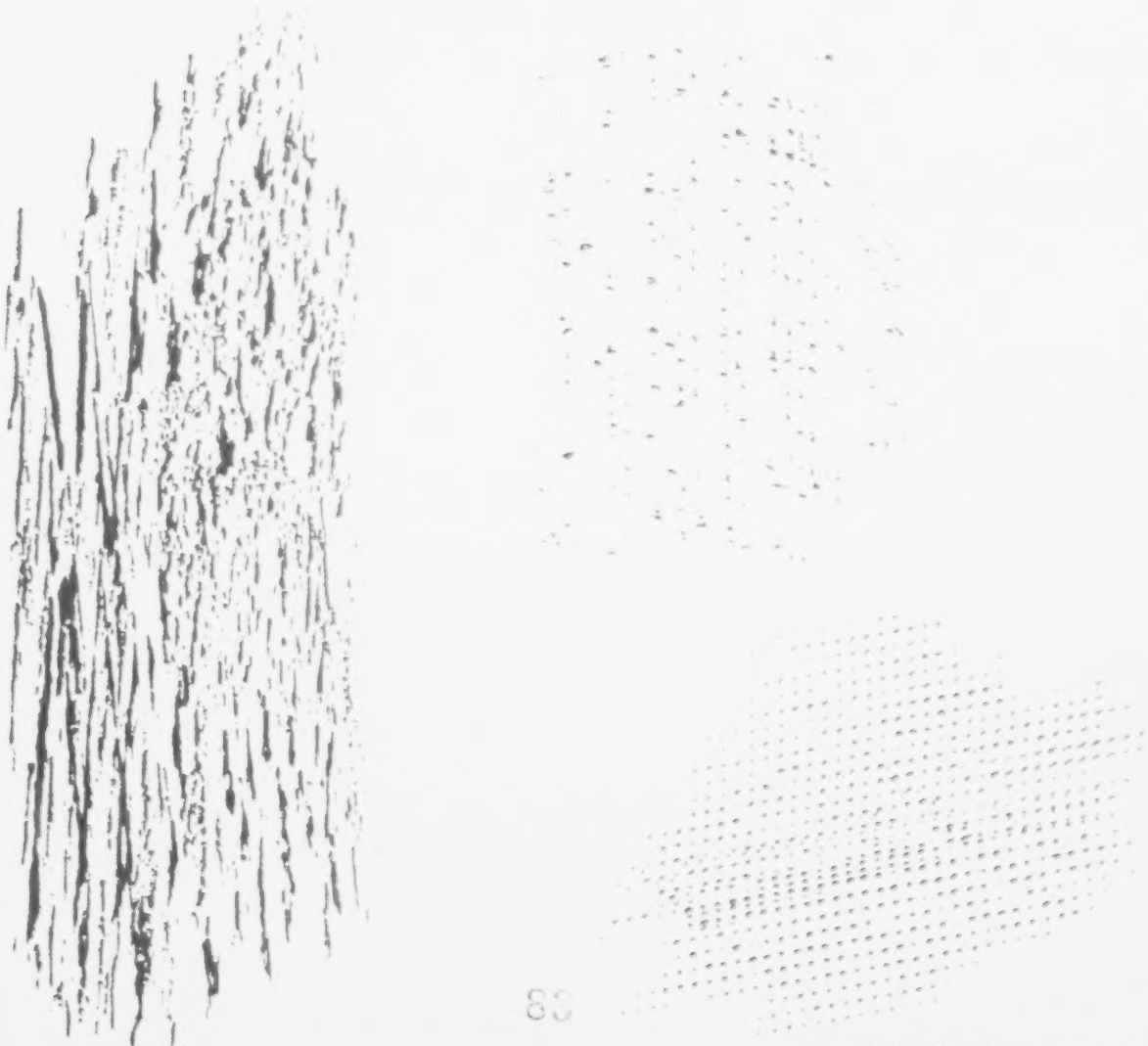
A RUBBING IS A MARK MADE BY PUTTING A SOFT PIECE OF PAPER OVER AN OBJECT AND RUBBING IT WITH A CRAYON OR PENCIL UNTIL THE IMAGE "SHOWS THROUGH" ON THE PAPER.

CREATE a design by taking rubbings from as many NATURAL objects as you can.

Some ideas: the ground
seashells
tree bark
leaves and plants
rocks
fossils

Turn your paper at different angles so your rubbings will overlap. Use different colors for variety. Fill the paper with the rubbings.

HINT: Newsprint is an excellent weight paper to use.



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COMPARE AND CONTRAST
LANDSCAPE ARTISTS

YEARS AGO A DUTCH ARTIST, VINCENT VAN GOGH (1853-1890) WAS PAINTING LANDSCAPES. HE IS WELL KNOWN FOR HIS UNIQUE STYLE OF PAINTING. HIS PAINTINGS ARE KNOWN FOR THEIR...

...movement
...force
...vigorous brush stroke
...rough textural surface quality
...deep rich color
...expressive qualities

COLLECT some art books with pictures of Vincent Van Gogh's paintings.

STUDY his style of painting.

DISCUSS his stylistic characteristics with your classmates.

THEN . . .

INVESTIGATE the well-known American artist, GEORGIA O'KEEFE.

O'KEEFE MOVED TO SANTA FE, NEW MEXICO FROM NEW YORK CITY TO PAINT THE DESERT. HER PASSION FOR THE DESERT IS REFLECTED IN HER WORK. O'KEEFE'S PAINTINGS ARE KNOWN FOR THEIR...

...rich pastel color
...blended brush strokes
...vast space
...smooth textural surface
...quiet, still quality

COLLECT some art books with pictures of Georgia O'Keefe's paintings.

STUDY her style of painting.

DISCUSS her stylistic characteristics with your classmates.

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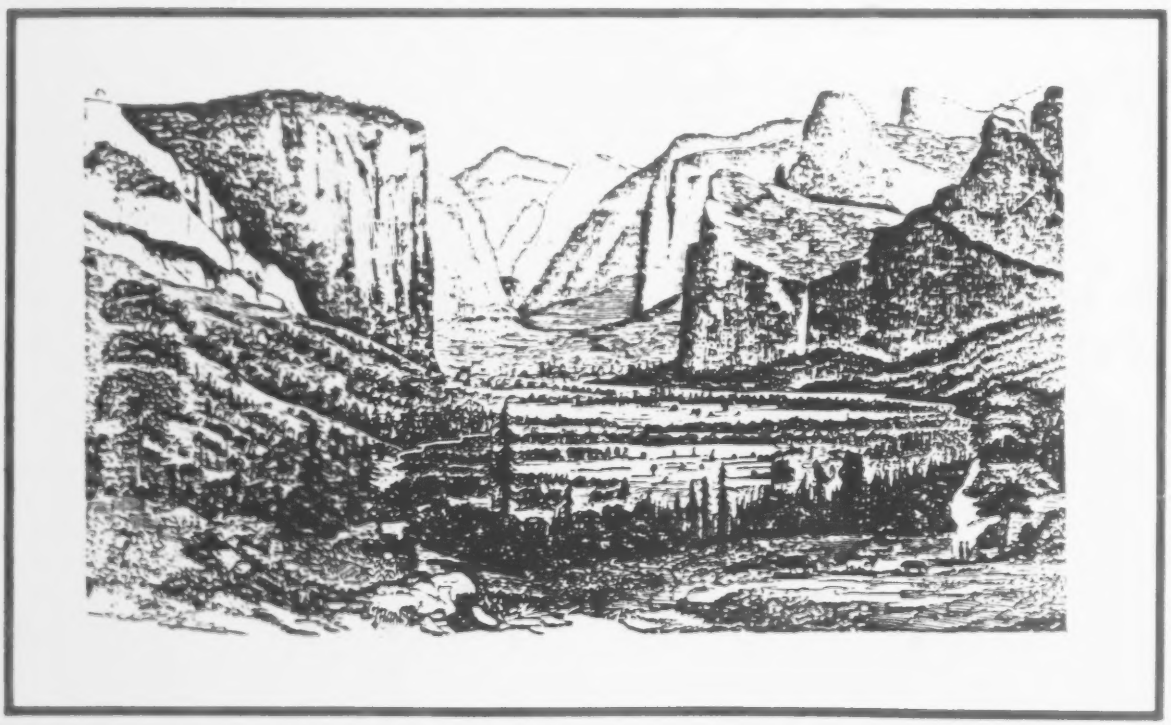
WHEN YOU UNDERSTAND THE DIFFERENCES IN THE TWO ARTISTIC STYLES . . .

CHOOSE one style.

PAINT a landscape of your own.

HINT: Work on paper at least 18"×24".

Expect to spend several hours on your painting as you develop the style in which you choose to work.



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